EXECUTIVE SUMMARY

INVESTIGATION OF INORGANIC MATERIALS DERIVED FROM WATER PURIFICATION PROCESSES FOR CERAMIC APPLICATIONS

MOTIVATION

Sludges and silts produced by waterworks and dredging operations often create disposal problems. Finding a use for such materials could eliminate or reduce these disposal problems, eliminate the spoiling of land or fouling of waterways, reduce disposal costs and create possibilities of financial return from the sale of products produced.

The supply of low-cost housing is a national priority and the manufacture of cheap bricks, blocks, and tiles in the rural and urban areas would help to alleviate this problem. The production of such building elements can also be labour intensive, thus supplying employment opportunities.

Work at MATTEK has identified waterworks sludge as a source of raw material for the production of bricks and tiles. The building elements developed either meet or are well below usual production costs. Extension of this work to other waterworks sludges shows possibilities. A feasibility study was carried out, based on an independent market analysis, for the manufacture of bricks, blocks and tiles. This study proved such manufacture to be a viable proposition.

OBJECTIVE

The main objective was to study the technical and economical feasibility of using waterworks sludges from Umgeni Water for the production of bricks, blocks, tiles or possibly other ceramic applications.

RESULTS

The suitability of the Wiggins Waterworks sludge for brickmaking and tilemaking was investigated.

Severe difficulties were experienced in all critical areas of ceramic processing, i.e. forming, drying and firing. Fortunately most of these difficulties have been overcome to a greater or lesser extent and valuable experience has been gained in processing waterworks sludge in general.

Whilst the pressing of tiles worked well, the pressing of bricks proved to be the greatest area of difficulty of the whole investigation. The major effort of the investigation was focused on overcoming this difficulty. The bricks pressed well in the die, but after being removed from the die for several hours they were prone to cracking. This difficulty has been largely overcome by optimisation studies.

The drying of the pressed tiles and bricks was originally thought to present no difficulties, but eventually it was found that this was the cause of the cracking of the unfired bricks. This was unexpected and very unusual because the drying shrinkage of the bricks was very low and in the case of extruded bricks this would normally never cause such a problem. This difficulty was overcome by perforating the bricks.

In the case of firing it was found that if the bricks or tiles were fired in the normal manner up to maximum temperature, usually in the range of 900° to 1000°C, they would crack or warp badly. This difficulty was overcome by introducing a calcination step at 600°C, to burn off deflocculants and organic matter. The firing cycle finally adopted was: one day to reach 600°C from room temperature, left for one day at 600°C, followed by an 80°C rise per hour to reach the required maximum temperature. This solved the problem of the cracking and warping for the tiles and the rings, but not for the solid bricks. It was found that noxious gases were evolved in the temperature range of 250°C to 550°C. This could be overcome by venting or scrubbing the gases.

CONCLUSIONS

It was concluded that the Wiggins Waterworks sludge would be suitable for producing rustic tiles and for manufacturing stock or face bricks.

ACHIEVEMENT OF OBJECTIVES

The technical feasibility of using the Wiggins Waterworks' sludge (Umgeni Water) for the production of bricks and tiles was demonstrated. Most of the difficulties experienced in the critical areas of ceramic processing, i.e. forming, drying and firing, have been overcome to a greater or lesser extent. This has provided valuable experience in processing waterworks sludge from other areas in South Africa.

RECOMMENDATIONS

It is recommended that a techno-economic feasibility study of glazed and unglazed tiles, including pilot plant trials, be undertaken on the Wiggins Waterworks sludge. It is further recommended that full-size perforated bricks be investigated, before pilot plant trials are undertaken on this sludge.

TECHNOLOGY TRANSFER

A summary of all the results obtained in this study will be made available to all water boards which have problems with the disposal of waterworks sludges.